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Microscopic structure of Pygmy Dipole Resonances in neutron-rich nuclei using transfer reactions

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Pygmy Dipole Resonances (PDR) are often referred as belonging to the new phenomenology specific of nuclei far from stability. PDR can be seen as new dynamical modes in neutron-rich nuclei associated with the excess neutrons. In most theoretical calculations, the dipole response of neutron-rich nuclei exhibits a small component at energies lower than the standard giant dipole resonance (GDR), often depicted as an oscillation of a deeply bound core against a neutron halo or skin.
In a pioneering work at GSI [1], clear evidence of pygmy dipole states in 130Sn and 132Sn was obtained at nearly 10 MeV excitation energy. While mean field calculations essentially agree on the excitation energy of the PDR in both nuclei, they provide contradictory interpretation of their microscopic structure. In the mean-field calculations for 130,132Sn, both approaches (relativistic and non-relativistic) find vanishing proton contribution so that the PDR are built only from neutron excitations in both cases. Neutron stripping reactions then appear as an adequate tool to probe the possible single-particle nature of the PDR in these nuclei. By using the (d,p) reaction in inverse kinematics, one could investigate whether these states involve sizeable contribution of neutron excitations coupled to the A-1 core.
The study of PDR structure using the (d,pg) in direct kinematics on the stable 120Sn and doubly magic 208Pb nuclei has been recently implemented with success [11,12]. Therein the analysis relies on a consistent description of the reaction and structure aspects which represent a valuable framework for our present investigation. We plan to apply the method implementing measurements in inverse kinematics with GRIT/AGATA/PARIS at SPES.

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